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COMPOSITE CEMENT ARTICLE INCORPORATING A POWDER COATING AND METHODS OF MAKING SAME

RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application Ser. No. 60/586,807 filed Jul. 9, 2004, the entirety of which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention generally relates to cementitious composite materials, and in particular, to a composite cement article that incorporates a protective powder coating and methods of manufacturing the article.

2. Description of the Related Art

Fiber reinforced cement (FRC) products are increasingly being used in a variety of building applications and in an increasing range of climatically different regions. Such products have gained favor for their inherent fire, water, pest and mold resistance, as well as their general affordability, which makes them particularly suitable for use in meeting commercial as well as residential building codes.

However, as with timber and other conventional building materials, exposure to the elements can cause physical and chemical changes in FRC products over time. Moreover, prior to installation, building materials are subject to physical damage during shipping and handling. To manage the detrimental effects of exposure and handling, it is known to protect FRC products with coatings or laminates or to attach protective means such as slip sheets to the products. Typically, laminates can be attached using adhesives and coatings can be applied directly to the product.

In cases where the fiber cement articles are treated by the application of laminates or surface coatings which rely primarily on mechanical keying or chemical bonding to the exterior surfaces of the substrate, the end product remains susceptible to both physical and chemical modes of degradation. Physical modes of degradation, for example, include thermal expansion and contraction, flexing due to wind loads. As such, these prior art surface coatings or laminates are prone to discoloration, delamination, blistering, and dimensional instability when affected by environmental agents.

Similar to environmental damages, mishandling during installation can also impact the service life of a fiber cement product as applied surface treatments may crack, tear or suffer abrasion damage or delamination. While manufacturers of FRC products typically recommend that the rear mounting surfaces of FRC panels be sealed appropriately, this is not always done correctly, if at all. If coatings are poorly applied, then different portions of the FRC product may weather at different rates depending on the degree of exposure and the integrity of sealers or other surface treatments. When different portions of the same FRC product weather at different rates, internal stresses may develop. If these stresses are significant, they can manifest themselves visually in the form of surface cracking of the panels or the coating or both and/or warping and the like.

Additionally, the existing factory processes for coating fiber cement products suffer from drawbacks. For example, treatment of the FRC products during conversion of the board base panel product into a customized cladding sheet is time and labor intensive and the product is thus correspondingly expensive. Also multiple types of coatings (e.g., primers, tie coats, topcoats, color coats, and clear coats) are often required

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to be applied and cured in sequence to achieve the performance requirements demanded of the composite surface while in use. Therefore, it would be desirable to substantially reduce the number of surface treatment and/or coatings required to simultaneously achieve the requisite performance needed by the composite surface in a given application. One example of this would be a coating that simultaneously is highly wear resistant, water repellant, maintains adhesion over a long exposure to freeze/thaw and UV exposure and is capable of achieving this with a substantially reduced coating film thickness.

It is also known in the art to provide reinforcing fibers or mesh to a fiber cement article to enhance the toughness, bending strength, or tensile strength of the article. For the purpose of this disclosure, when fibers are referred to, it will be implied that the fibers may be in the form of long continuous fibers, short discontinuous fibers, or meshes of fibers having a regular, such as woven, or irregular, such as non-woven, appearance.

Fibers themselves can be comprised of natural or synthetic polymers or blends thereof. Blends of natural and synthetic polymers can also be used to enhance fiber cement composite performance. Natural cellulose fibers are inexpensive, resistant to degradation in an autoclave, hydrophilic and relatively easy to disperse in hydraulically settable binder composites like FRC. However, they are also shorter and not efficient at enhancing toughness or bending strength. Polymeric fibers can be made in many configurations and lengths but are hydrophobic and more difficult to process in hydraulic pastes and slurries. Also, only certain types of polymer fibers are resistant to autoclave conditions. Using blends of cellulose and polymeric fibers requires multiple material handling streams and the resulting composite properties can be limited by the need to manage the undesirable properties of each type. Handling multiple fiber types also can add to the manufacturing cost of a fiber cement article. It would therefore be desirable to find a way of combining the favorable features of polymeric and cellulosic fibers.

Both cellulose and synthetic polymeric fibers may also have treatments that are used to enhance or optimize the bonding or distribution of the fibers to the cementitious matrix wherein they are distributed or placed. These treatments often involve cured polymeric or polymerizable materials. Examples of these fiber treatments are disclosed in PCT patent applications W00228796, entitled "FIBER CEMENT COMPOSITE MATERIALS USING CELLULOSE FIBERS LOADED WITH INORGANIC AND/OR ORGANIC SUBSTANCES" and W00228795, entitled "FIBER CEMENT COMPOSITE MATERIALS USING SIZED CELLULOSE FIBERS", which are herein incorporated in full as references. However, the preparation of reinforcing fibers, especially when the surfaces are treated, involves additional processing steps that add to the cost of an FRC composite product.

It is thus an object of the present invention to provide a fiber cement composite article and methods of making that article which will overcome or ameliorate one or more of the disadvantages of the prior art.

SUMMARY OF THE INVENTION

In one aspect, the preferred embodiments of the present invention provide a cementitious composite article. The composite article comprises a cementitious substrate having a first surface, a powder coating layer formed on the first surface, and a surface interface interposed between the first surface and the powder coating layer. The surface interface facilitates